Does the "Feebate" Approach to A/E Compensation Lead to an Energy-Efficient Building?*

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Abstract

The idea of a "feebate," in which the designers of a building receive payment based on the building's energy performance, has been proposed as a means of encouraging energy efficiency in commercial buildings. To demonstrate this approach, in 1995 the City of Oakland California held a design competition to select a design/build firm for a large commercial building project that involves both new construction and substantial retrofit. The winning team will be subject to financial incentives based on the building's energy performance during the second year of occupancy. If the building fails to meet the target energy efficiency level (roughly 20% less than the state code's energy requirements), then the design team will pay the City a penalty; likewise if the building exceeds the target energy efficiency level, then they receive a reward. Our paper reports on an evaluation of the process up to the construction phase of the project, which commenced in early 1996. Through nine interviews with the client, design/build firm and their subcontractors, and other consultants and participants in the project, we draw a picture of the process and the course it has followed through the design phase of the project. Different perspectives, conflicting incentives, and imperfect communication among the players during the programming, design competition, and design phases lead to designers not taking the "carrot" offered and only focusing on the "stick." We draw lessons offered by interviewees and from our own analysis of this pioneering project.

Introduction

One of the most significant barriers to the realization of energy efficient new buildings is that designers' incentives are often indifferent to or in conflict with that outcome. Architectural and engineering (A/E) designers are rarely compensated for the extra effort required to explore alternative design solutions that save energy and money; indeed, traditional fee structures can even penalize them for doing so since aggressive load reduction can result in major equipment down-sizing (the cost of which provides the basis for some trades' compensation) and commensurate reduction in fees. Even when this barrier is surmounted and an energy efficient design is secured on paper, designers and builders are not bound by a performance standard to ensure that the building performs as promised. This predicament is painstakingly documented in a paper by Amory Lovins (1992).

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Performance-based A/E compensation is a means of changing the incentives for designers towards designing and ensuring more energy efficient buildings. Also known as “feebates,” the idea is to encourage more energy efficient design by granting monetary rewards, and to discourage substandard energy performance by exacting penalties, all based on the actual performance of the building as built. In this way, designers are rewarded for efforts that bring value in the form of energy cost savings to the owner, while compensating the owner for having to shoulder higher energy bills in the case of a poorly performing building. Yet, in spite of significant discussion, awareness, and widespread approval of the feebate concept among energy pundits, energy-conscious designers, and environmentalists, as evidenced by articles (Malin 1995) and workshops (AIA 1994) on the subject, the idea has not caught on.

Feebates are similar to energy savings performance contracts (ESPCs) except that the latter are almost exclusively used in retrofit situations where the baseline energy consumption is more straightforward. In the case of feebates, the baseline is some target energy efficiency level defined by the owner. Another distinction is that compensation to energy service company providers is often based on shared savings defined over some period in the ESPC of up to ten years or more, whereas compensation to A/E firms under a feebate arrangement is generally conceived to be an up front payment occurring within a few years of project completion. Finally, ESPCs usually involve third-party financing for energy conservation measures, whereas feebate and energy conservation costs are expected to be owner-financed.

The first demonstration of the feebate—that we are aware of—is currently underway in Oakland California. Despite the intent of the owner reported upon at the Third National New Construction Programs for DSM Conference (Eley et al. 1995), they did not secure a design for their proposed project that was any more energy efficient than the minimum they required. What follows is an exploration of what happened in the process up to start of construction, and what lessons might be gleaned from it.

Background

In 1995 the City of Oakland, California, held a design competition to build new administration space as both retrofit to an existing building and new construction for a total of 450,000 ft^2 with a budget of $80 million. The competition featured three design/build teams who were chosen from an original list of eight. The three teams prepared bids that, for all intents and purposes, constituted a schematic level of design. The winner, chosen in the summer of 1995, proceeded to develop the design and prepare for construction on a fast-track schedule. The project is scheduled for completion by the middle of 1997.

Early on, the City of Oakland was intent on developing an energy-efficient project. They began by using a prescriptive approach in developing the specifications for the project, but came to realize that their goals would not be met through these conventional means. The City contacted the California Energy Commission (CEC) and solicited assistance under their Energy Partnership Program that provides technical assistance to local governments in California to make energy efficiency improvements in their new and existing facilities. The CEC retained a consultant to work with the City who by coincidence had been involved in roundtable discussions organized by the American Architects Association (AIA) on the subject of performance-based A/E compensation (AIA 1994). The idea of using the feebate approach was broached initially, and after extensive discussion and refinement, was formally adopted by the City as part of their RFP.

The feebate approach adopted by the City contained specific language on several elements.

Performance Target

The minimum level of energy efficiency was specified in terms of energy cost per annum per unit floor area. The level chosen by Oakland for this project, $1.08/ft^2/year, is about 25% more efficient than that required by the state code. Using cost instead of energy or other units afforded a means of combining into one measure the impacts of design choices on energy, peak demand, and multiple fuels, thus accounting for benefits of load management and fuel switching in addition to energy conservation. In this way, the signal of complicated utility tariff structures is made transparent. It also pointed directly towards the bottom line that was more readily grasped by decision-makers. Bidders were required to prove their designs would reach or exceed the target in theory, and the contractor chosen to construct the project was required in addition to prove it in practice.

Modeling

The means of determining energy performance with respect to the target was through building energy computer simulation modeling. Use of the DOE-2.1 model was required of all bidders, who were given, as part of the bid package, an initial input of the base case building meeting the target, which they were to modify to describe the building they were proposing while proving that its energy performance was at least as good as the target. The winning contractor was also required to prove at several design review milestones that the design meets or exceeds the target. A key rationale for using a model was to allow the City to make adjustments to the target for factors that are beyond the control of the contractor. These factors are weather; occupancy, lighting, and other schedules or modes of operation; changes in utility tariffs; plugs loads, elevator use, and hot water consumption. Initially the target was defined based on assumptions of the above factors, but later modified using actual values. In this sense, the model *is* the energy performance target.

Monitoring

In the second year post-construction, a full year of monitoring is required to make proper adjustments to the target and to compare actual energy performance to the adjusted target. The building energy management system is to be used to collect the information needed to make the adjustments. The first year post-construction is reserved as a shakedown period for the contractor to trouble-shoot and fine-tune the building operation through a building commissioning process that the contractor is required to undertake.

Incentive and Penalty

Based on the outcome of actual performance versus the adjusted target following the second year post-construction, the design/build team is subject to incentives (if they exceed the target) or penalties (if they fall short of the target). Payment is to occur as a one-time, lump-sum transaction at the end of the second year. For the Oakland project the incentive/penalty is structured as three key elements: (1) the difference between adjusted target and actual annual unit energy cost is multiplied by 5 for the incentive and by 15 for the penalty, (2) this amount is capped at $250,000 for both the incentive and penalty, and (3) there is dead-band where no money exchanges hands if the difference is $10,000 or less. The multiplier is used to extend a single year's effects to multiple years. Ideally, the multiplier would be based on life-cycle costing using discount rates of the parties involved, which would put it in the neighborhood of around 20-30. In this case the selection of the multiplier was somewhat arbitrary. The reasoning behind the multiplier on the incentive being lower than on the penalty side was that the City wanted to capture some of the monetary benefits of energy efficiency beyond the target. The reasoning behind the cap was political expediency. There was a sense that the Oakland City Council would not agree to an open-ended liability and would not be willing to pay any more than $250,000 even if they were to receive much higher value through future energy cost savings. And with the incentive capped, for fairness reasons the penalty was capped as well. The reasoning behind the dead-band was an acknowledgment of some margin of error in modeling. Initially the dead-band was set at 2% on either side of the target, but based on strenuous argument on the part of bidders, the dead-band was increased to 4%.

Approach

Our approach consisted of reviewing printed project documentation and interviewing key participants in the project from inception to start of construction. The project documents included the Request for Proposals and other materials provided to bidders, and reports of the consultant (Eley Assoc. 1994; Eley et al. 1995). Interviews were conducted in December 1995 and January 1996 of fourteen key participants in the project. The interviews included: the project manager and energy engineer for the City of Oakland; the consultant to the performance contracting process for the City of Oakland; the programmer for the design build competition; the project manager, managing architect, design mechanical engineer, design electrical engineer, and energy analyst of the winning design build team; the project managers for the two losing bidders; the energy analyst from one of the losing bidders; and the program manager supporting the performance contracting effort from the CEC. All interviews were conducted either in person or by phone by one of the authors, recorded on audio tape, and transcribed to word-processor documents. The interviews followed a loosely structured format with questions posed as shown in Annex 1. At the time interviews were conducted, the design development stage of the project was nearly completed, and foundation work had begun at the construction site.

Participant Perspectives

Results of nine of the fourteen interviews are reported here, representing the full range of perspectives and most salient views expressed. The interview responses are grouped together and paraphrased in order to mask views of particular individuals.

Design/Build Teams

"It was a beauty contest." All bidders agreed that aesthetics were the key to winning the design competition, not energy efficiency. They predicted (apparently rightly) that nobody on the jury particularly cared about energy efficiency so none of the teams expended extra effort to improve energy efficiency, but only enough to demonstrate minimum compliance with the target.

All the teams (including the winning bidder) interpreted many of the energy efficiency aspects of the building program as prescriptive, and therefore stifled their ability to innovate.

There was unanimous skepticism about the ability of DOE-2.1 to accurately model their designs and in particular to determine compliance with the target. All teams saw DOE-2.1 as a "black box" with a multitude of inputs of uncertain value and questionable accuracy. The model was not seen as a "proven" tool in this type of application (i.e., with significant amounts of money in design fees on the line). All teams hired special consultants to run DOE-2.1.

All teams (including the winning bidder) saw the penalty side of the feebate only. They perceived it as a risk factor that was put into their margins, which ultimately subtracts from the amount available to design and construct the building. Furthermore, losing bidders objected in principle to the idea of an incentive or penalty altogether. One expressed concern that offering an incentive implies that the design/build team isn't providing the client with the highest life cycle value as a matter of course. "In selecting a design/build team, the City is selecting a relationship because many collective decisions have to be made down the line, so energy performance penalties are incompatible with establishing such a relationship." Another stated that since they interpreted all important energy design aspects of the building as already defined in a prescriptive sense, it was unfair to hold them to a specific performance level and penalize them for non-performance.

Losing bidders expressed bitterness about the amount of money spent to prepare bids, including that to perform detailed energy modeling at such an early stage of design. They considered it "irresponsible" to ask bidders to spend so much, which is bad for the industry because firms will go out of business or stay out of such competitions for fear of doing so, and because ultimately those costs will come out of projects thus reducing value to clients. Bidders were unanimous in saying that modeling should only be done when the building design is at a later stage. The City should have chosen the team based on qualifications or conceptual design, without demonstrating at that stage that their design would meet the energy target.

Losing bidders had no confidence in public sector operations and maintenance practices. Despite the normalization techniques defined in the RFP for factoring out the effects of these practices, they felt that even if they designed an energy efficient building that met or exceeded the target, it might be corrupted by inadequate O&M beyond their control.

Another problem with public sector development of projects under a feebate arrangement mentioned by a losing bidder is the sense of "paranoia" on the part of public institutions at being cheated, which results in highly prescriptive specifications that discourage innovation. "Each public sector job results in a fatter spec."

The winning team felt they won the competition because they delved into what the City wanted in detail, not because of energy performance per se.

The general contractor is sharing the risks and rewards of the feebate with some of the other team members, but not with all whose work contributes directly to energy performance of the project. The reason for this was due to individual negotiations and apparent (successful) opposition by some team members to having their fees tied to performance. In spite of this loophole for some, one of the team members commented that the feebate was "causing the trades to work together more closely."

The winning team is not particularly interested in winning the reward; they are primarily averse to paying the penalty. In other words, they don't view incentives and penalties symmetrically. They interpreted the feebate as liquidated damages in preparing their bid. They saw the risk of paying a penalty of $250,000 for not meeting the target as higher than other risks such as construction schedule overruns. The latter risk they have control over, but consider the former risk a "crapshoot" because "it is a design penalty or bonus, not a construction penalty or bonus." Not unexpectedly, in general they do not like the penalty side of feebates and tried to think of some alternative way of guaranteeing performance to the client, but acknowledged that tying money to performance was key to making it work. However, the general contractor did like one aspect of the penalty side of the feebate because it gives them more leverage with subcontractors and their performance, especially to complete jobs.

Building Owner/Client

Since the rules of the game were set by the client, the views they expressed were primarily in reaction to bidders actions and comments. They were particularly surprised that energy efficiency elements described in the DOE-2.1 model provided to bidders were interpreted as prescriptive and discouraging of innovation instead of illustrative of how one could achieve the target they set and open to design innovation. They expressed surprise that none of the teams proposed designs that went beyond the target.

From the City's perspective, they "would rather lose the $250,000 and get a more efficient building than be paid a penalty by the contractor." The City participants saw ample opportunity for discussion and negotiation with the winning team during the design phases of the project to enhance the energy efficiency of the design from the original and to aggressively pursue energy saving opportunities during commissioning.

The City participants agreed that they would do some things differently next time. They would like to eliminate the caps and have symmetric and larger multipliers of between 20-30 (instead of 5-15) on the incentives and penalties. They would also like to present information in a future RFP to assuage bidder concerns about some of the unknowns. These might be presented in the form of tables or graphs that reveal the magnitudes of the effects of different assumptions on targets and incentives/penalties.

The cap on the penalty is actually unnecessary (as suggested by one City participant) because it is in essence already capped by the option available to the contractor to make further investments at finite cost to increase energy efficiency in the building, either as hardware or software (i.e., fine-tuning operation) that would limit the penalty payment to the client.

"Two-thirds of the effort in implementing the feebate approach here was persuasion and meetings, and one-third of the effort technical and engineering."

Lessons

A number of lessons can be drawn from the rich experience of this early trial of the feebate approach to motivating designers and builders towards more energy efficient buildings. Many of the lessons echo decisions the City of Oakland came to and implemented themselves, others draw from mistakes or perceived shortcomings of the effort. These lessons are a mixture of observations from the interviewees and reflections of the authors.

- Do not require bidders to perform detailed modeling at the bidder selection stage.

- Keep prescriptive criteria at a minimum to allow for innovation.

- Set dead-band around the target performance level to account for inaccuracies in the model algorithms and monitoring and uncertainties in the model inputs.

- Energy cost is a convenient metric for the target because it accounts for the effects of complicated tariff structures (for load management approaches), different valuation of fuels (for fuel switching approaches), and owner appreciation for the bottom line.

- Establish symmetric penalties and incentives for fairness.

- Incentives and penalties should be based on the life cycle energy cost differential between the performance target and actual performance. This translates into a multiplier on annual energy costs of somewhere between 20 and 30 depending on expected building lifetime and discount rates.

- It makes sense to use a one-year shakedown period followed by a one-year monitoring period to determine actual energy performance for purposes of establishing incentives or penalties to be paid. The shakedown period allows the contractor to fine-tune and trouble-shoot both the building and the monitoring systems. The one-year monitoring year is useful in order to capture the effects of seasonality on building energy performance.

- Motivation for contractors to conduct more thorough building commissioning may be the single largest effect of feebates.

- It is crucial to have mechanisms for tying sub-contractor performance to the overall energy performance contract and its risks and rewards. Leaving this to the general contractor as was done here may not achieve the desired outcomes, particularly in the early evolutionary stages of the feebate process. Providing guidelines or examples of how this might be done to contractors might help to close this loophole.

- Caps on the penalties and incentives may be necessary for some time in order to acquaint the building industry to the energy performance contracting process, but should ultimately be phased out as risks are reduced from better understanding. If caps are going to be used, they should be based upon expected annual energy costs (either as a fraction or multiple of), not total project costs.

- The energy performance target must be adjusted for variables that are beyond the designers' control. This is easier said than done. Translating monitoring outputs into modeling inputs is a non-trivial task. Invariably phenomenon will be taking place in the building that will be difficult to accurately model. Following monitoring guidelines, such as the North American Energy Monitoring and Verification Protocol (NEMVP) (DOE 1996), could reduce the risk of technical and legal challenges down the line.

- From the designer and builder perspective, the risk of paying penalties is analogous to liquidated damages—a concept the building community is familiar with and frequently uses in their business.

- Owners need to communicate the importance of energy efficiency to bidders both explicitly and implicitly if they want these issues taken seriously. It is not enough to just include feebate contractual clauses. The tenor and content of written and verbal communications with bidders needs to reinforce the client's desire for an energy efficient building. Similarly, the jury choosing the design team has to include knowledgeable and influential advocates of energy efficiency issues.

- Of the various building development processes, the design/build process for owner-occupiers probably best lends itself to energy performance contracting. Applying feebates in a more typical design/bid/build process would be more complicated contractually, and require the A/E design team to assume greater responsibilities. A/E designers will find it difficult to take on the liability of energy performance contracting on their own, given their resources, typical compensation levels, and current insurance and bonding practices in these professions.

- Spec building development may be the most challenging situation in which to apply feebates since developers are unlikely to value savings in operating costs unless or until the market does. Even if a spec building is built under a feebate arrangement, tenants will probably have to be incentivized in a comparable way to A/E designers to encourage relatively energy efficient interior design.

- While some might view public-sector clients as the vehicle for promoting the feebate concept in this nascent stage, they may not be ideal due to rigid, bureaucratic practices, highly risk-averse tendencies (such as highly prescriptive specifications) and a lack of confidence on the part of the building community in the adequacy of operation and maintenance in public buildings that is perceived to put contractor remuneration at risk.

- Champions are a must for instituting energy performance contracting into any development process. Obviously it is critical that the champion either be the client or have the ear of the client.

- Much of the effort in undertaking a feebate approach at this stage is politics and persuasion rather than technical, although analysis revealing the range of possibilities inherent in the various clauses can help to reduce discomfort and perceptions of risk.

Conclusion

These lessons draw on the initial phases of this innovative project. We plan to continue our evaluation of the progress of this building through construction and occupancy to learn what influence—if any—the feebate approach has on the commissioning and operation of the building. Will this building be a low-energy building? Can this approach be applied to other buildings? Based on the experience of this project we hope to develop guidelines for future demonstrations of this approach in both the private and public sectors, and where projects are developed outside a design/build framework.

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Annex 1. Questionnaire

1. How did you get involved in the project?

2. What was/is your role in the project?

3. What were/are your overall objectives?

4. How did/does energy efficiency figure into your thinking about the project?

5. What influence did/does the energy performance contract have on your decisions?

6. What was/is the effect of the following energy performance contracting aspects on your work:
   a) target efficiency level ($1.08/kBtu/sq. ft.)
   b) upper and lower bound caps on the incentive ($250,000)
   c) the incentive in relation to the overall project budget ($80 million vs. $250,000)
   d) the asymmetry of the penalty vs. incentive (15x penalty, 5x incentive)
   e) the base case building DOE-2.1 prototype
   f) the first-year shake down period following construction
   g) the second-year measurement period for comparison to the target
   7. What was/is your strategy for achieving the energy goals?

8. Are you happy with the ways things have turned out?

9. What things would you like to see done differently?

10. What do you anticipate will happen in the latter phases of the project (construction, commissioning, occupancy, measurement)?

11. What are the important lessons?

12. How should energy performance contracting be done for this type of design-build project in the future? What about for more standard design-bid-build type projects?